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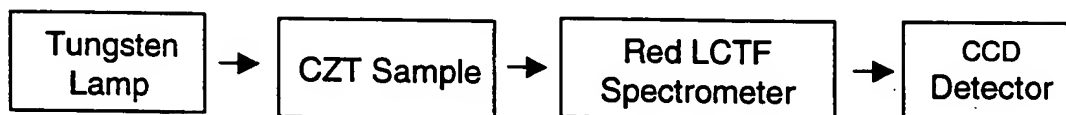
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EXHIBIT

A

Project Title: Chemical Imaging for Semiconductor  
Metrology  
Project No.: 98ATP01  
Date: April 6, 1999

**CHISM**  
**CZT NIR Transmittance Imaging Test Configuration**  
**Block Diagram**

**Sample**

- CZT etched and unetched

**Source**

- Tungsten lamp

**Dispersive Spectrometer**

- Entrance slit = 100  $\mu\text{m}$
- Spectrometer = 0.5 m
- Grating = 1200 gr/mm

**CCD Detector**

- Thermoelectrically cooled to  $-40^{\circ}\text{C}$
- 512 x 512 pixels
- Pixel size = ~~9  $\mu\text{m}$~~   $24 \mu\text{m} \times 24 \mu\text{m}$
- CCD exposure = 3 seconds

**Comments**

- Date: March 19, 1999
- Red Falcon Microscope

**Microscope Configuration**

- Objective: 20X
- N.A.: 0.46

**LCTF Scanning Parameters**

- 830 – 900 nm
- Step size: 5 nm



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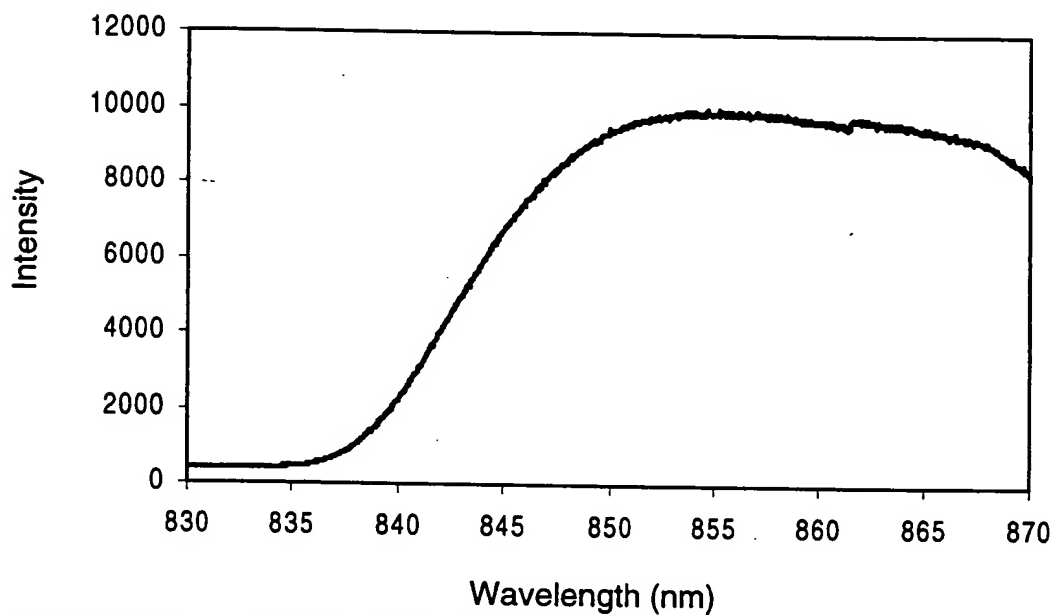
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### CHISM CZT NIR Transmission Spectroscopy



Comments In order to determine the



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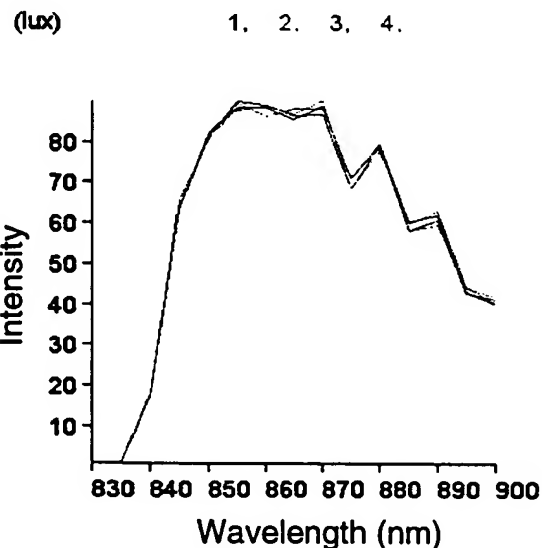
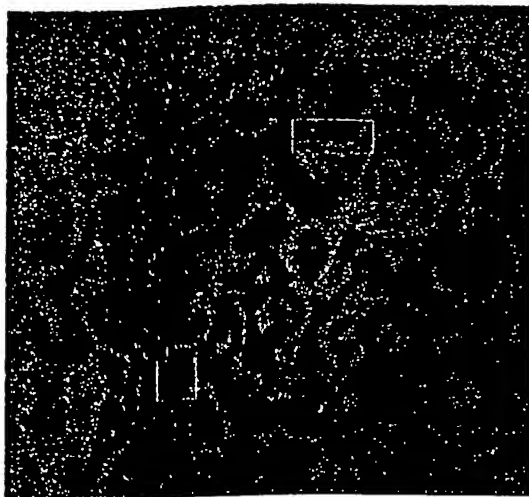
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Project No.: 98ATP01  
Date: April 6, 1999

## CHISM

### Typical NIR LCTF Microspectra of Unetched CZT



**Spatial Results** Little contrast is visible in the NIR image except for an inherent instrumental response

**Spectral Results:** There is little variation in spectral profiles taken at locations 1-4.

**Location:** Quadrant 0,3

**File Name:** D:\ATP\990322\_JMR\_027 \_\_CZT\_allcos.tif

**Data:** Cosine Correlated

**Wavelength:** 880 nm

**Comments** We may address the instrumental response issue seen in these NIR images by Fourier transform analysis



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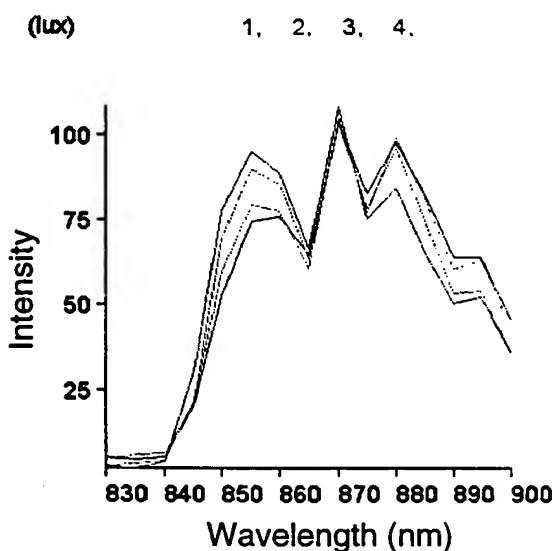
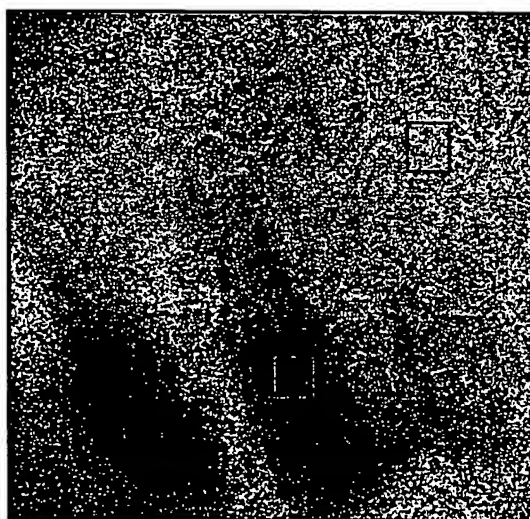
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Project No.: 98ATP01  
Date: April 6, 1999

## CHISM

### NIR LCTF Microspectra of Etched CZT (Defect Type 1)



**Spatial Results:** Spatial contrast can be seen in relatively large regions.

**Spectral Results:** Spectral variations are evident at locations 1-4.

**Location:** Quadrant 0,4

**File Name:** D:\ATP\990322\_JMR\_005 \_\_CZT\_allcos.tif

**Data:** Cosine Correlated

**Wavelength:** 855 nm



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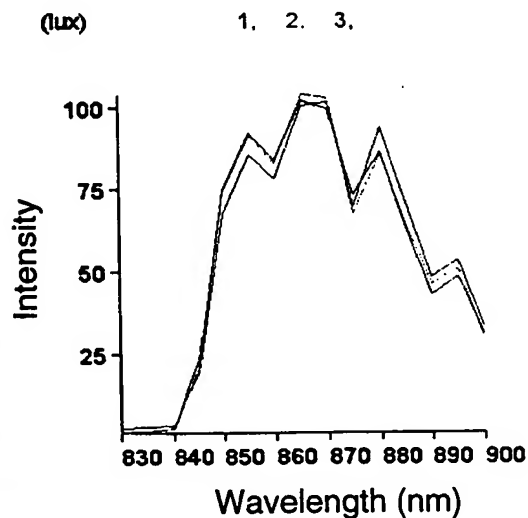
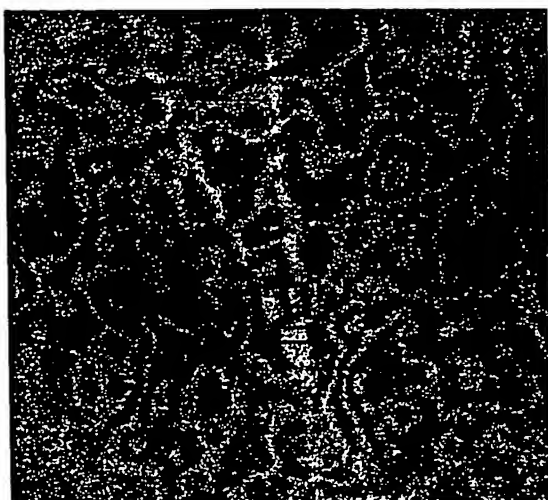
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Project Title: Chemical Imaging for Semiconductor Metrology  
Project No.: 98ATP01  
Date: April 6, 1999

**CHISM**  
**NIR LCTF Microspectra of Etched CZT (Defect Type 2)**



**Spatial Results:** Spatial contrast can be seen here at the junction of two fine scratches.

**Spectral Results:** Spectral variations are evident at locations 1-4.

**Location:** Quadrant 0,3

**File Name:** D:\ATP\990322\_JMR\_004\_CZT\_allcos.tif

**Data:** Cosine Correlated

**Wavelength:** 880 nm



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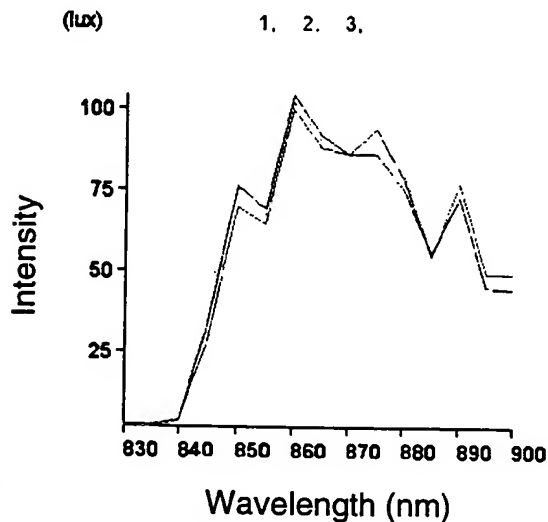
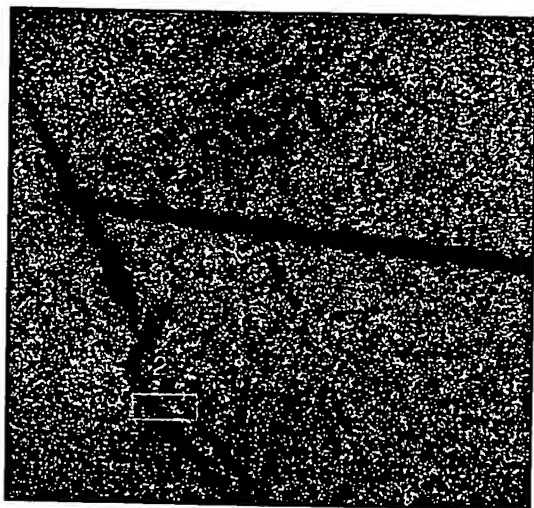
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Project No.: 98ATP01  
Date: April 6, 1999

**CHISM**  
**NIR LCTF Microspectra of Etched CZT (Defect Type 2)**



**Spatial Appearance:** Spatial contrast is evident here at the junction of three fine scratches.

**Spectral Results:** Spectral variations are evident at locations 1-4.

**Location:** Quadrant 3,0

**File Name:** D:\ATP\990322\_JMR\_016 \_\_CZT\_allcos.tif

**Data:** Cosine Correlated

**Wavelength:** 850 nm

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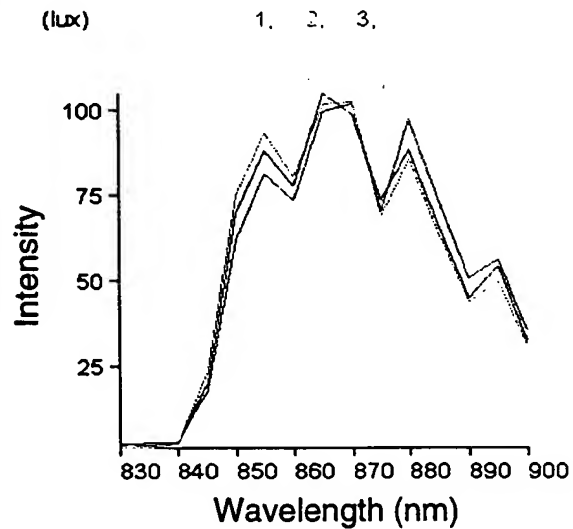
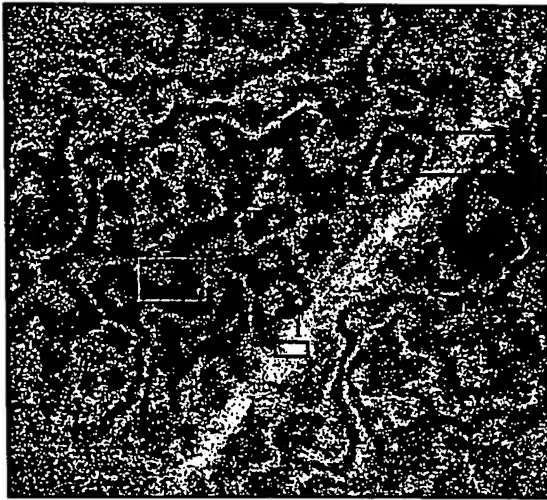
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Project Title: Chemical Imaging for Semiconductor Metrology  
Project No.: 98ATP01  
Date: April 6, 1999

**CHISM**  
**NIR LCTF Microspectra of Etched CZT (Defect Type 3)**



**Spatial Results:** Spatial contrast can be seen here over a prominent surface scratch.

**Results:** Spectral variations are evident at locations 1-4.

**Location:** Quadrant 0,2

**File Name:** D:\ATP\990322\_JMR\_003 \_\_CZT\_allcos.tif

**Data:** Cosine Correlated

**Wavelength:** 880 nm



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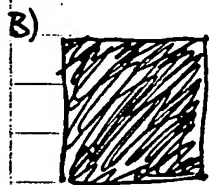
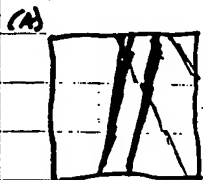
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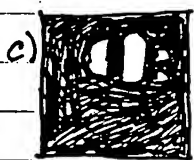


62. IMAGE OF TWO SCRATCHES THAT APPEAR DARK AND RUN PARALLEL, AND ARE ONLY FAINTLY VISIBLE TO THE SCRATCHES <sup>SIGNIFICANTLY</sup> DARKER UNDER THE U-AN AND U-OP FILTERS, BUT THEY DISAPPEAR ENTIRELY WHEN BOTH FILTERS ARE IN PLACE (B).



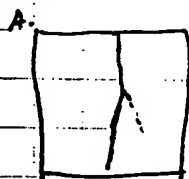
990415-JMR-062-C2T.tif (R)  
990415-JMR-062-C2T-allows.tif (C)

THE SCRATCHES WERE CLEARLY VISIBLE <sup>USING</sup> WITHIN PHOTOLUMINESCENCE. (C)



A THIRD SCRATCH ALSO SEEMS TO BE VISIBLE, INTERSECTING THE RIGHT PARALLEL SCRATCH. (R)

63. IMAGE OF TWO SCRATCHES CONVERGING, DIVERGING.



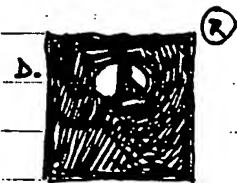
A. IS THE VIEW FROM THE VIDEO MONITOR. ONE SCRATCH IS VIRTUALLY VISIBLE, ALTHOUGH FAINT, AND THE OTHER BRANCHES OFF AT A 45° ANGLE AND FADES AWAY.



B. UNDER THE U-AN FILTER AND THE U-OP FILTERS SEPARATELY, THE SCRATCHES APPEAR DARKER AND MORE DEFINED. THE SIDE SCRATCH DOES NOT APPEAR TO FADE AWAY. OTHER SCRATCHES AND DEFECTS APPEAR.



C. WITH BOTH U-OP AND U-AN FILTERS IN PLACE, ONLY THE SIDE SCRATCH IS VISIBLE.



D. THE RAW DATA SET SHOWS THE JUNCTURE OF THE TWO SCRATCHES <sup>(DRAWN AT 840nm)</sup> A THIRD SCRATCH APPEARS BETWEEN THE OTHER TWO CREATING A SEEMINGLY HORIZONTAL BAR IN A CAPITAL "A". THIS THIRD SCRATCH ~~WAS~~ WAS NOT VISIBLE PRIOR. (R)

990415-JMR-063-C2T.tif (R)  
990415-JMR-063-C2T-allows.tif (C)

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